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EXAMINER

OWENS, DOUGLAS W

ART UNIT	PAPER NUMBER
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2811

DATE MAILED: 04/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/601,387

Applicant(s)

FORNOF ET AL.

Examiner

Douglas W Owens

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 30-75 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 30-75 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 6/23/03, 7/2/03, 2/17/04
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

## **DETAILED ACTION**

### ***Claim Objections***

1. Claims 51, 57 and 69 are objected to because of the following informalities:

There is no antecedent basis for the term "the buried etch stop layer" in line 3 of claim 51.

There is no antecedent basis for the term "said hardmask layer" in claim 57.

In claim 69, "decomposition" should be replaced with "decomposing".

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 31 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 30 requires providing a dielectric layer from which the porogen has been removed. Claim 31, the dependent claim, requires an additional step of removing the porogen. The scope of what is being claimed is not clear, since it requires removal of what has previously been removed.

### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

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(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 30 – 32, 70, 71 and 74 are rejected under 35 U.S.C. 102(e) as being anticipated by US Patent No. 6,451,712 to Dalton et al.

Regarding claim 30, Dalton et al. teaches a method of forming an electrical interconnect structure on a substrate, comprising:

providing a first porous dielectric layer with a surface region from which porogen has been removed (Col. 6, lines 26 – 28); and

forming an etch stop layer (Col. 6, lines 32 – 36) upon the first porous dielectric layer so that the etch stop layer would have filled pores in the surface region of the porous dielectric.

Regarding claim 31, Dalton et al. teaches a method, wherein the porogen is removed from the surface region.

Regarding claim 32, Dalton et al. teaches a method, wherein the porogen is removed by heating.

Regarding claim 70, Dalton et al. teaches a method, wherein the first porous dielectric layer is comprised of a low k dielectric material.

Regarding claim 71, Dalton et al. teaches a method, wherein the dielectric layer has a thickness in the range of 1000 – 10000 Angstroms (Col. 5, lines 57 – 59), which falls within the claimed range.

Regarding claim 74, Dalton et al. teaches a method, wherein the thickness of the etch stop layer is less than 250 nm, which includes the range of 200 – 600 Angstroms.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 33 – 40, 42 – 59 and 62 – 69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al.

Regarding claim 33, Dalton et al. teaches using a hot plate for removing porogen (Col. 5, lines 52 – 55). Dalton et al. does not explicitly teach baking in a hot plate chamber. It would have been obvious to one of ordinary skill in the art to bake the porogen in a hot plate chamber since it is desirable to control the process.

Regarding claim 34, Dalton et al. teaches a method of forming an interconnect structure, wherein a single or dual damascene structure can be formed. Dalton et al. does not explicitly teach forming a second porous dielectric layer. It would have been obvious to one of ordinary skill in the art to form a second porous dielectric layer since it is desirable for completion of a dual damascene structure. Additionally, it has been held that mere duplication of parts has no patentable significance unless a new and unexpected result is produced (*In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960)).

Regarding claims 35, 62 and 68, Dalton et al. teaches a method, wherein the porous dielectric material is organic (Col. 5, lines 31 – 33).

Regarding claims 36, 58 and 69, Dalton et al. teaches a method, wherein the dielectric layer is made porous by decomposing sacrificial porogen initially in the layer.

Regarding claims 37 and 59, Dalton et al. does not explicitly teach forming the first and second dielectric layers of the same or different materials. It would have been obvious to one of ordinary skill in the art to select the same or different materials since

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there is no other option. The two materials must be the same or different, no other choice is possible.

Regarding claims 38 and 39, Dalton et al. teaches a method, wherein the thickness of the dielectric layer overlaps the range of 600 – 5000 Angstroms (Col. 5, lines 57 – 59). In the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990).

Regarding claim 40, Dalton et al. teaches a method, wherein the etch stop layer is comprised of a material with etch selectivity to the porous dielectric layer.

Regarding claims 42 and 66, Dalton et al. teaches a method, wherein the etch stop layer has a thickness less than 250 nm, which includes the range of 200 – 600 and 300 – 1000 Angstroms.

Regarding claim 43, Dalton et al. teaches forming a metal via (54) in the first porous dielectric layer.

Regarding claims 44 – 46, Dalton et al. teaches a method that may be used to form a dual damascene structure, which would have required a metal line in the second porous dielectric layer.

Regarding claim 47, Dalton et al. teaches a method that includes curing the dielectric layers to render them porous.

Regarding claims 48 and 63, Dalton et al. does not teach curing multiple layers in a single step. It would have been obvious to one of ordinary skill in the art to cure the dielectric layers in a single step, since it is desirable to reduce process times.

Regarding claims 49 and 64, Dalton et al. teaches a curing step conducted at a temperature of 450 degrees C (Col. 6, lines 8 – 12) for a period long enough to drive out the second phase polymeric material (make porous). Dalton et al. does not teach curing for 15 minutes to 3 hours. It would have been obvious to one of ordinary skill in the art to arrive at the optimal time period through routine experimentation, since the optimal time is not disclosed by Dalton et al. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Regarding claim 50, Dalton et al. teaches a method, wherein the remaining porogen is removed during the curing step.

Regarding claims 51 and 65, Dalton et al. inherently teaches a method, wherein the remaining porogen degrades to low molecular weight compounds and diffuses out of the layer through free volume of the dielectric layer during the curing step, since the method is identical to that of the claimed invention.

Regarding claim 52, Dalton et al. does not teach curing the dielectric layers in a single tool after sequential application. It would have been obvious to one of ordinary skill in the art to cure the dielectric layers in a single tool, since it is desirable to reduce process steps.



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Regarding claim 53, Dalton et al. teaches spin coating the wafer. Dalton et al. does not teach a method, wherein the spin coating tool contains high temperature hot plate baking chambers. It would have been obvious to one of ordinary skill in the art to use a tool having high temperature hot plate baking chambers since it is desirable to prevent contamination of the wafer by unnecessary moving.

Regarding claim 54, Dalton et al. teaches a method, wherein the patterned metal conductor is a via.

Regarding claim 55, Dalton et al. teaches a method, wherein at least one of the patterned metal conductors would be line in a dual damascene structure.

Regarding claims 56 and 67, Dalton et al. teaches a method, further comprising forming a hardmask layer on the second porous dielectric layer (Col. 6, lines 28 – 32; Col. 7, lines 42 – 50), so that the hardmask layer extends to partially fill pores in surface regions of the dielectric layer.

Regarding claim 57, Dalton et al. teaches a method, wherein the hardmask layer is a CMP stop layer (Col. 6, lines 32 – 36).

8. Claims 41, 60, 61, 72, 73 and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al. as applied to claims 30 – 40 and 42 – 59 above, and further in view of US Patent No. 6,603,204 to Gates et al.

Dalton et al. does not teach a method, wherein the etch stop layer is selected from the group consisting of organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organosilsesquioxanes, and siloxanes. Gates et al. teaches a spin on etch stop layer with selectivity to the porous dielectric layer comprising hydrido silsesquioxane (Col. 4,

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line 64 – Col. 5, line 3). It would have been obvious to one of ordinary skill in the art to incorporate the teaching of Gates et al. into the method taught by Dalton et al., since it is desirable to provide reliable materials for the etch-stop layer.

Regarding claim 75, Dalton et al. does not teach an adhesion promoter on the substrate. Gates et al. teaches an adhesion promoter on the substrate (Col. 8, lines 9 – 13). It would have been obvious to one of ordinary skill in the art to incorporate the teaching of Gates et al. into the method of Dalton et al., since it is desirable to prevent subsequently deposited layers from peeling.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas W Owens whose telephone number is 571-272-1662. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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*Handwritten signature: Steven P. Lee*